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A CORRELATIONAL STUDY OF SELF-REPORT MEASURES AND EMG MEASURES OF ANXIETY

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled "A Correlational Study of Self-Report Measures and EMG Measures of Anxiety" submitted by Eleanor M. Ballantine in partial fulfillment of the requirements for the degree of Master of Education in Counselling Psychology.

ABSTRACT

One hundred and sixty subjects were involved in a study of the relationship between psychological and physiological correlates of anxiety. The sample comprised 56 males and 104 females who ranged in age from 16 to 62 years, with a mean age of 29.4.

Three instruments were used to assess anxiety level. Two self-evaluation inventories of anxiety, the State-Trait Anxiety Inventory (Spielberger, Gorsuch, and Lushene, 1970) and the IPAT Anxiety Scale Questionnaire (Self-Analysis Form) (Cattell and Scheier, 1963) were the psychological measures. Frontal EMG under baseline conditions was the physiological measure. Correlations between the two measures were determined by computing the Pearson product-moment correlation coefficient.

The results of the study indicated that self-evaluated anxiety, as measured by the IPAT, correlated significantly with muscle tension levels, as measured by frontal EMG ($r=.194$, $p=.014$). The correlations of subjective anxiety (A-State and A-Trait), as assessed by the STAI, and frontal EMG measures of muscle tension were not significant. Since the sample was amply large to provide reliable results, discussion focused on essential differences in format in the STAI and the IPAT in explaining the results.

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CHAPTER 1

INTRODUCTION

The experience of anxiety seems to be intrinsic to the human condition. It has a universal quality. Presumably, man has experienced anxiety as long as he has existed as a species, although the contents of his anxieties and the attendant circumstances are, no doubt, a function of the mores and assumptions of the cultures in which he has lived (McReynolds, 1975). The construct of anxiety has been extensively researched from many theoretical perspectives but, regardless of its import, a consensus as to its nature is conspicuously lacking (Fischer, 1970).

It is generally accepted that anxiety is both psychological and physiological in nature. Everyday experience provides many indicators of the close relationship between how one feels and how one responds. Our language expresses it quite effectively. An anxious person frequently describes himself as "feeling uptight", "having butterflies in his stomach", "breaking into a cold sweat", or "having a knot in his stomach". Research also provides ample evidence of a relationship between the psychological and physiological concomitants of anxiety (Alexander, 1975; Duffy, 1972; Greer, Ramsay, & Bagley, 1973; Schachter & Singer, 1962; Valins, 1967). However, the differential importance placed on each aspect varies according to the theoretical orientation of the researcher.

Psychological Component of Anxiety

Anxiety, as a psychological concept, is ambiguous. This is due to

a lack of consistency in the terminology used to describe it. Spielberger (1966, 1972) specifies the failure to distinguish between anxiety as a transitory emotional state and anxiety as a relatively stable personality trait as a source of the problem.

Generally, anxiety is viewed as an unpleasant emotional state characterized by feelings of tension and worry and accompanied by increases in physiological arousal. Some writers in defining anxiety, place strong emphasis on the cognitive factor. Lazarus and Averill (1972), for instance, regard man as an evaluating organism whose appraisal of a situation as threatening elicits an anxious response. Anxiety results when cognitive systems no longer allow an individual to relate meaningfully to the world about him. Schachter (1966) views the labeling of physiological arousal as the crucial element in an anxiety experience. Others demonstrate the role of "self-verbalizations" (Meichenbaum, 1971) and "internalized statements" (Ellis, 1973) in mediating an anxiety response. Anxiety, then, may be viewed as an unpleasant emotional reaction which occurs in an individual who perceives a situation as personally threatening. Individual differences in personality dispositions and past similar experiences strongly influence the appraisal. An increase in physiological arousal accompanies the reaction.

Measurement of the Psychological Component of Anxiety

Since anxiety as a psychological construct is basically descriptive, efforts to assess it include clinical evaluation and introspective reports. Self-report measures of anxiety typically use adjectives (e.g., jittery, restless, uneasy) or brief statements (e.g., I feel tense;

I am regretful) describing feelings which the individual rates on a subjective scale. Reported reliability and validity data of individual instruments suggest that these are useful and acceptable measures of anxiety (Cattell & Scheier, 1963; Martuza & Kallstrom, 1974; Spielberger, Gorsuch, & Lushene, 1970).

Physiological Component of Anxiety

Many researchers (Budzynski, 1973; Martin, 1961; Stoyva & Budzynski, 1974; Wolpe, 1958) concur that anxiety is accompanied by various physiological changes. These changes are in the direction of increased heart rate, skin conductance, respiration rate, blood pressure, and muscle tension levels. Increased muscle tension is one of the more commonly recognized components of an anxiety response. The majority of clinical reports link anxiety with muscle tension. Malmo and Shagass (1949) found greater physiological response in the autonomic and skeletal muscular systems in patients whose complaint was anxiety as compared with those in whom anxiety was a minor complaint or absent, and normal control subjects. Other investigators (Balshan, 1962; Haynes, Moseley, & McGowan, 1975; Wilkinson, 1978) also provide evidence of a positive relationship between anxiety and muscle tension.

Measurement of the Physiological Component of Anxiety

Since increased muscle tension is a commonly recognized component of an anxiety reaction, methods of measuring it are of interest. Muscle tension is most meaningfully defined in terms of muscle contraction. When a muscle contracts, an electrical impulse is generated along the muscle fiber. This impulse spreads from the muscle to the skin. The total amount of voltage at the skin varies with the number of muscle

fibers contracting simultaneously (Malmo, 1970). Electromyography is used to estimate quantitatively this electrical activity in muscle mass (Lader & Mathews, 1971). This involves the detection, amplification, and recording of the muscle action potentials that are produced when motor units fire (Goldstein, 1972). Although the electrical activity which the electromyogram (EMG) records actually occurs prior to the contraction of the muscle, "the integrated surface EMG provides a measure of electrical activity in muscle which is doubtless related to muscle contraction...." (Grossman & Weiner, 1966, p. 82). Although any accessible muscle group can be monitored, studies using EMG usually record the activity of the frontalis (forehead) muscle because it is considered to be a particularly sensitive indicator of muscle tension.

Since muscle activity is reportedly the best single physiological correlate of anxiety (Reinking & Kohl, 1975), assessing the EMG level of the frontalis muscle will provide a valid measure of individual anxiety level.

The Problem

Some research evidence does suggest the existence of a positive relationship between the psychological and physiological correlates of anxiety (Haynes et al., 1975; Malmo & Smith, 1949; Smith, 1973). It would seem, then, that anxiety level may be assessed equally well through either introspective reports or physiological measures. However, the literature on anxiety suggests that anxiety states can be most meaningfully defined in some combination of the two (Spielberger, 1972). Accordingly, studies relating EMG to subjective reports of tension are extensive (Alexander, French, & Goodman, 1975; Mathews & Gelder,

1969; Matus, 1974; Raskin, Johnson, & Rondestvedt, 1973; Reinking & Kohl, 1975; Smith, 1973). However, results are inconsistent. Significant correlations have been obtained in some studies (Bird, 1979; Haynes et al., 1975; LeBoeuf, 1977; Matus, 1974; Smith, 1973) while nonsignificant correlations have been found in others (Alexander et al., 1973; Mathews & Gelder, 1969; Sime & DeGood, 1977).

Some factors which may have contributed to the conflicting results of previous studies are sample size and type of population. In general, the studies have involved relatively small samples. A few investigators (Alexander et al., 1975; Sime & Degood, 1977), in reporting their results, actually attribute the non-significance of the results to the small number in the sample. Also, in view of the findings of Cameron (1944) and, more recently, LeBoeuf (1977) that muscular symptoms are predominant in some anxious individuals and not in others, a small sample restricts the possibility of obtaining a good representation of subjects who are muscularly reactive. Thus, low correlations may be expected.

Another consideration is the clinical populations involved in some studies. Clinical patients are generally considered to have higher muscle tension levels than the normal population. Also, Balshan (1962) has noted that "the chronic anxiety observed in psychoneurotic patients is probably quite different from the anxiety assessed by manifest anxiety scales" (p. 445). This would seem to limit the generalizability of the findings.

The present study, which is an outgrowth of Hiebert's (1979) comparative study of EMG feedback and alternative treatments of anxiety, re-examined the relationship between psychological (self-report mea-

sures) and physiological (muscle tension levels) correlates of anxiety. Since inconsistent evidence has resulted from the previous studies, most of which used small samples, and some of which involved patient populations (chronically anxious subjects), it seemed useful to re-investigate the relationship using a larger sample. Therefore, the present study, comprising 160 subjects from the normal population, was undertaken.

CHAPTER II

REVIEW OF THE RELATED LITERATURE

The Nature of Anxiety

The construct of anxiety has great theoretical and practical importance as evidenced by the extensive research it has generated. Anxiety, it appears, is a complex concept with little consensus as to its nature (Fischer, 1970). Several theorists (Cattell & Scheier, 1958; Endler, 1975, 1976; Eysenck, 1975; Izard, 1972), however, suggest that anxiety is a multidimensional construct. Izard (1972) postulates that anxiety is "a variable combination of fear and two or more of the fundamental emotions of distress, anger, shame (including shyness and guilt) and interest-excitement....Anxiety is always a complex of fundamental emotions and their interactions" (p. 102). Anxiety, as conceived by Cattell, is a personality trait whose components are ego weakness, ergic tension, guilt proneness, defective integration of the self-sentiment, and protension or suspicion.

Using factor analysis, Cattell and Scheier (1961) identified two distinct anxiety factors, trait anxiety and state anxiety. Trait anxiety is defined as a relatively permanent and stable characteristic, and state anxiety as a transitory condition which varies over time.

Spielberger (1966, 1972) maintains the distinction between trait and state anxiety and contends that much of the conceptual confusion with respect to anxiety results from the failure of researchers to do likewise. He points out that trait and state anxiety are two related, yet logically very different constructs. Spielberger defines state anxiety (A-State) as a complex emotional reaction "consisting of un-

pleasant consciously-perceived feelings of tension and apprehension, with associated activation or arousal of the autonomic nervous system" (p. 29). A-State is a transitory condition that varies in intensity and fluctuates over time. Trait anxiety (A-Trait) refers to relatively stable individual differences in anxiety proneness. A-Trait predisposes an individual to perceive a wide range of stimulus situations as threatening and to respond with A-State reactions.

Spielberger seems basically concerned with the effects of ego-threatening stressors in the evocation of anxiety. According to Spielberger (1972), fear of failure and self-deprecation are the basic characteristics of a high A-Trait person. Such a person is, therefore, more likely to perceive ego-involving situations as more threatening than would a low A-Trait individual and to respond with much greater A-State arousal in such situations.

Endler (1975, 1976) is critical of Spielberger's position on the basis of its restrictiveness to ego-threat as the source of anxiety. Recent research (Endler & Hunt, 1969; Endler & Magnusson, 1976; Endler & Shedletsky, 1973) indicates that anxiety is evoked not only by threats to self-esteem but by physical danger and ambiguous events as well. Cognitive worry and emotional arousal have been identified as two other dimensions of anxiety (Meichenbaum, 1972, 1975; Morris, Smith, Andrews, & Morris, 1975; Sarason, 1975). Consequently, Endler posits an interaction model of anxiety (Endler, 1975; Endler & Hunt, 1969) which provides a basis for expanding Spielberger's position by examining the nature of person-by-situation interactions. Both trait and state anxiety are considered to be multidimensional constructs (Endler & Hunt, 1969).

Therefore, an anxiety reaction would be elicited by the interaction of person and situation provided the A-Trait dimension is congruent with the threatening situation.

Behavioral Components of Anxiety

Other psychologists focus on different aspects of anxiety according to their particular orientation. Researchers who are behaviorally oriented tend to regard anxiety as a characteristic pattern of conditioned responses made by an organism to certain stimuli (Eysenck, 1969, 1973; Wolpe, 1958, 1969). Eysenck (1969) views anxiety as a conditioned fear response. He points out that pain reduction is the primary drive in anxiety, and that neutral stimuli associated with pain give rise to "fear" responses which are very similar to responses to pain. The strength of the conditioned fear reaction depends on the degree of emotionality or fearfulness and the strength of conditioning (Eysenck, 1973).

Wolpe (1958) defines anxiety as the central constituent of neurotic behavior, any persistent habit of maladaptive behavior acquired through learning in a physiologically normal individual. Thus, anxiety is "the autonomic response pattern or patterns that are characteristically part of the organism's response to noxious stimulation" (p. 34). Anxiety becomes attached through a conditioning process (learning) to neutral environmental events.

From a behavioral point of view, then, anxiety is accompanied by an increase in physiological arousal. Anxiety can be identified by observing an individual's behavior pattern under stress which usually contains a strong, maladaptive component.

Psychological Components of Anxiety

The importance of cognitive factors in anxiety phenomena are emphasized by many theorists (Beck, 1976; Ellis, 1973; Lazarus, 1966; Lazarus & Averill, 1972; Meichenbaum, 1971; Schachter, 1966; Valins, 1967). Lazarus and Averill (1972) regard man as an evaluating organism whose cognitive processes (appraisal) mediate between his environmental situation and his emotional response. The individual searches his environment for cues about what is needed or desired, evaluating each input as to its relevance and importance. Every emotion must be understood in terms of a particular kind of appraisal. Anxiety, therefore, "is an emotion based on an appraisal of threat, an appraisal which entails symbolic, anticipatory, and uncertain elements" (p. 247). Because the source of threat cannot be clearly identified, no rationally based action to dispel the danger can be utilized (Lazarus, 1966).

Schachter (1966) postulates that the evaluative processing of information from bodily sensations is the crucial element in an anxiety experience. Labels are cognitively, situationally, or socially determined. The arousal state is labeled depending on how the individual understands or explains it. The labeling process itself is influenced by what the person attributes as being the origin of the arousal. Behavior, then, is a result not only of environmental situations, but of the individual's perception of these situations.

Physiological changes alone will have little effect on emotional behavior unless the individual can attribute these changes to environmental stimuli. As a result of a series of experiments involving false heart-rate and its effect on subjective reactions to emotional stimuli

(Valins, 1966, 1967; Valins & Ray, 1967), Valins concludes that bodily changes incite the cognitive processes which influence one's subjective and behavioral reactions to emotional stimuli.

Other investigators have examined the role that self-verbalizations, internalized statements, and automatic thoughts play in mediating behavior and behavioral change. These cognitions appear to intervene between the situation and the resulting behavior. Meichenbaum (1971), in a study of snake-phobic subjects, found that a self-verbalizing coping model facilitated greater behavioral and affective change than a mastery model. Other studies involving impulsive hyperactive children (Meichenbaum & Goodman, 1971) and test-anxious college students (Meichenbaum, 1972) have also demonstrated the efficacy of therapeutically attending to the individual's self-verbalizations as well as to his overt, maladaptive behavior in modifying behavior.

McReynolds (1975) observes "the essence of the cognitive approach to anxiety theory is that a person's anxiety is the natural resultant of a state of discrepancies, imbalances, or conflicts...among his mental thoughts, feelings, and memories" (p. 22).

The cognitive position sees the individual as the mediator between his environment and his emotional reaction to it. It is the cognitive process that generates anxiety.

Physiological Components of Anxiety

Psychologists, regardless of their theoretical orientation, recognize physiological arousal as a component of anxiety. Budzynski (1973) states that heightened arousal is associated with anxiety. Although individual variations in arousal patterns do exist, the direction of the

changes is generally toward increased heart rate, skin conductance, respiration rate, blood pressure, and muscle tension levels (Budzynski, 1973; Martin, 1961; Wolpe, 1958).

Anxious individuals tend to over-react physiologically to threatening stimuli. Malmo (1957), therefore, has designated anxiety a "disease of overarousal", and the highly anxious individual as one who "reacts to ordinary life situations as though they were emergencies" (Malmo, 1970, p. 67). Not only does the anxious person tend to react excessively, but he also takes longer to return to pre-stimulation level than the non-anxious person (Budzynski, 1973; Malmo, 1970). Malmo (1970) suggests that this over-reaction to and slow recovery from stress in the chronically anxious person may be due to an impairment in the brain mechanisms that normally control muscle tension (p. 83).

Increased muscle tension levels are often associated with anxiety. Brown (1977) states that "the most popular current theory of the mechanisms underlying muscle tension posits that the organism is 'aroused' or 'alerted' by threatening stimuli, and the arousal activates a physiological preparation of the body to take action" (p. 33). Muscle tension diminishes slowly. Therefore, if muscles are not given relief from tension by relaxation or change of activity, the muscle fibres physiologically adapt to the states of increased tension.

Researchers have investigated the relative contributions of genetic and environmental factors in the development of excessive muscular tension. While some evidence for a genetic basis has been advanced (Jost & Sontag, 1944; Eysenck, 1956), most theorists favor an explanation based on environmental factors (Budzynski, 1973; Haugen, Dixon, & Dickel, 1958;

Whatmore & Kohli, 1968). Budzynski posits that, in some instances, excessive muscle tension is maintained through reinforcement. Others (Budzynski & Stoyva, 1972; Haugen et al., 1958; Whatmore & Kohli, 1974) attribute its maintenance to a lack of awareness of its presence. It seems that people usually recognize only higher and more prolonged peaks of muscle tension than they ordinarily produce (Haugen et al., 1958). Whatmore & Kohli (1974) attribute the sustained muscular tension to a bracing error, which they call dysponetic bracing. It occurs in situations where quick and vigorous overt action would be inappropriate. The origins of dysponetic bracing are not yet clearly determined but it is considered always inappropriate and detrimental to the individual. They posit that sustained bracing may develop "via a conditioning process wherein bracing becomes conditioned to more and more environmental stimuli until finally it is occuring in almost any situation" (p. 69).

EMG Feedback and Muscle Tension

Cognizant of the adverse effects of prolonged exposure to excessive muscle tension, therapists have employed different relaxation techniques (e.g., progressive relaxation, autogenic training) with varying therapeutic success. In recent years EMG biofeedback has been used. Biofeedback is "the process of feeding back physiological information to the individual generating the information" (Brown, 1977, p. 3). In EMG biofeedback the electrical activity of muscles is monitored, providing the individual with information about muscle tension level. Evidence is accruing that biofeedback is a fast and effective technique for reducing muscle tension (Budzynski, 1973; Budzynski & Stoyva, 1972; Canter, Kondo, & Knott, 1975; Haynes et al., 1975; Philips, 1977; Reinking &

Kohl, 1975; Townsend, House, & Addario, 1975). In a critical review of published reports on clinical applications of feedback training, Blanchard and Young (1975) conclude that "the soundest evidence...lies in the area of EMG feedback training" (p. 221).

Studies using EMG feedback usually record the activity of the frontalis muscle. Because this muscle is difficult to relax voluntarily (Shagass & Malmo, 1954; Balshan, 1962), it is assumed that once an individual achieves a high degree of control over this muscle, the procedure should be readily applicable to other less difficult muscle groups. Some reports indicate that successful frontalis training has led to general bodily relaxation (Budzynski, 1973; Budzynski & Stoyva, 1972). However, Alexander (1975) found no evidence that frontal EMG training generalized to untrained forearm and lower leg muscles. More recently, Schandler and Grings (1976) have reported that all feedback groups displayed significant reductions in both extensor (feedback source) and frontal EMG activity. Moreover, they suggest that significant reductions in other physiological response measures displayed by the feedback groups may further reflect a generalized relaxation effect from the specific muscle feedback source to physiological systems other than skeletal muscles (p. 425).

Anxiety has been demonstrated to be a multidimensional phenomenon. To fully appreciate and comprehend the impact on man, more careful scrutiny of these dimensions and their interactions is called for. In the present study the relationship between the psychological and physiological aspects of anxiety was investigated. With this focus in mind, the following research is pertinent.

Previous Studies

A number of previous studies have examined the nature of the relationship between psychological and physiological correlates of anxiety. Studies within a treatment context generally report correlations between self-report measures of anxiety and muscle tension levels (EMG) as a result of treatment. Those not in a treatment setting report correlations between self-ratings of anxiety and resting frontalis EMG level. Regardless of context, correlations tend to be low (Lader & Mathews, 1971).

Mathews and Gelder (1969) and Reinking and Kohl (1975) compared various forms of relaxation training and found that although relaxation did effectively reduce both frontal EMG levels and personal feelings of anxiety, the correlations between the two measures were not significant. Other investigators (Alexander et al., 1975; Sime & DeGood, 1977) have reported similar findings. However, muscle tension level and self-perceived state anxiety (STAI) were found to be significantly related in introverts (LeBoeuf, 1977) and in subjects who had received awareness education (Bird, 1979).

Studies involving chronically anxious subjects (Lavallee, La Montagne, Pinard, Annable, & Tetreault, 1977; Raskin et al., 1973; Townsend et al., 1975) also report discrepant results. While a low correlation was obtained in the study by Raskin et al., Townsend et al. found change in mood disturbance and in trait and state anxiety (STAI) to be significantly correlated with change in EMG levels. Lavallee et al. (1977) reported EMG activity was significantly correlated with the total score on the Hamilton Anxiety Scale, and positively, though not

significantly correlated with the IPAT total scores.

The results of studies using resting EMG levels as the physiological measure of anxiety have been more consistent. Haynes et al. (1975), in a study involving the largest reported sample (101 Ss), found manifest anxiety and baseline EMG average were positively related. This finding was supported by Smith (1973), who reported a positive correlation between resting frontal EMG level and trait anxiety (IPAT), and by Matus (1974), who reported a significant correlation between resting frontal EMG and extraversion-introversion.

Hypotheses

On the basis of the preceding discussion, which provides some evidence of a relationship between muscle tension and self-ratings of anxiety, and a larger sample, the following hypotheses were delineated for empirical investigation:

1. A positive relationship between state anxiety, as measured by the STAI-S, and muscle tension level, as measured by frontalis EMG level, will be indicated.
2. A positive correlation between trait anxiety, as measured by the STAI-T, and muscle tension level, as measured by frontalis EMG level, will be obtained.
3. Anxiety, as measured by Cattell's IPAT, will be positively correlated with muscle tension level, as measured by frontalis EMG level.

CHAPTER III

METHODOLOGY

Sample

The subjects were the same as those in the anxiety control project conducted by Hiebert (1979) at the University of Alberta, from which the present study is an outgrowth.

The sample comprised 160 subjects, 56 males and 104 females. Subjects ranged in age from 16 to 62 years, with a mean age of 29.4. Of the 160 subjects, 110 were university students and 50 were non-students.

Instrumentation

Three instruments were used to assess anxiety level. Two self-evaluation inventories of anxiety, the State-Trait Anxiety Inventory (STAI) (Spielberger, Gorsuch, & Lushene, 1970) and the IPAT Anxiety Scale Questionnaire (Self Analysis Form) (IPAT) (Cattell & Scheier, 1963) were the psychological measures. EMG under baseline conditions was the physiological measure.

State-Trait Anxiety Inventory. The STAI is a 40 item self-evaluation inventory designed to measure and distinguish between transitory anxious states (A-State) and relatively stable personality dispositions toward anxiety (A-Trait) (Spielberger et al., 1970). Twenty items ask the individual to describe how he/she feels at the particular moment (A-State items). Twenty items ask him/her to describe how he/she generally feels (A-Trait items).

The STAI has been used extensively in anxiety research (Alexander et al., 1975; Bird, 1979; LeBoeuf, 1977; Martuza & Kallstrom, 1974;

Townsend et al., 1975). The test-retest reliability coefficients of the A-Trait scale range from .73 to .86, which are high. Those for the A-State scale, .16 to .54, tend to be low, as would be expected for a measure designed to reflect the influence of situational factors. Internal consistency coefficients, which Spielberger considers a more meaningful index of the reliability of the A-State scale, are high, .83 to .92 (Spielberger et al., 1970). The validity data is reported to be satisfactory (Kendall, Finch, Auerbach, Hooke, & Mikulka, 1976; Martuza & Kallstrom, 1974; Spielberger et al., 1970).

IPAT Anxiety Scale Questionnaire. The IPAT anxiety scale, a product of Cattell's extensive studies of the factorial structure of personality, consists of 40 items designed to measure both the overt and covert aspects of anxiety (Cattell & Scheier, 1963).

Reliability data is highly satisfactory. Test-retest reliability coefficients range from .82 to .93. Split-half coefficients range from .80 to .91 (Cattell & Scheier, 1963). Guilford (1959) reports a split-half reliability coefficient of .84 in a normal population and .91 in a mixed normal and clinical population.

Validity data for the IPAT is also satisfactory. Construct validity coefficients are reported to be between .85 and .90 (Cohen, 1965). External validity coefficients are between .30 and .40, obtained by comparing IPAT scores with psychiatric consensus as reported by the authors. Greer, Ramsay, and Bagley (1973) report "high and signifcant" correlations between clinical ratings of anxiety and IPAT scores. Cohen (1965) and Smith (1973) report significant correlations between IPAT scores and physiological measures.

EMG. An Autogenics Systems Inc. 1700 electromyograph was used to measure EMG levels for each subject. Surface electrodes were applied in the standard manner for measuring frontal EMG (Budzynski, 1973; Wilkinson, 1976). The muscle tension information from each group of four subjects was processed simultaneously using the Autogenic Systems Inc. 5600 data acquisition center and printer assembly.

EMG baseline levels were obtained in the usual manner. After attaching surface electrodes to the frontal region (two line electrodes placed one-inch above the eyebrow vertically above the center of the eye with a ground mid-way between), subjects were instructed to relax as completely as possible, using whatever technique they usually found effective. After a brief pause (30 seconds) to allow subjects to settle themselves, EMG recording was begun. An average microvolt level was recorded at 10-second intervals over a 90-second period. This procedure was repeated twice. The average over the three trials constituted the baseline level for each subject.

Procedure

All assessments used in the study were taken during the initial session of each group. Each session began with a short explanation by the experimenter about the project in general. Immediately thereafter subjects were given the STAI with the instructions:

> A number of statements which people have used to describe themselves are given below. Read each statement and then blacken in the appropriate space on the answer sheet to indicate how you feel. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your feelings best. The first 20 statements refer to how you _feel right now_;

> the last 20 refer to how you <u>generally feel</u>.
> Do not skip any items.

As each person finished, the STAI and the separate answer sheet were collected. When all subjects were finished, the IPAT was administered with the following instructions:

> Inside this booklet you will find 40 items dealing with difficulties that most people experience at one time or another. It will help a lot in self-understanding if you check Yes, No, etc., to each statement, frankly and truthfully, to describe any problems you may have. Mark all your answers on the answer sheet. Use the "Inbetween" or "Uncertain" box only if you cannot possibly decide on A or B. Never pass over an item but give some answer to every single one. Do not spend time pondering. Answer each immediately the way you want to at this moment.

Upon completion of the second questionnaire, all writing materials were collected.

A short presentation on the nature of anxiety followed. The presentation concluded with a discussion on muscle tension as a correlate of anxiety and the function of EMG in monitoring muscle tension. The electrodes were then attached to the forehead region of each subject using standard procedure. When all subjects were ready, the lights were turned off, and they were instructed to relax as completely as possible using whatever technique they usually used to relax. After a brief pause to allow subjects to settle themselves, EMG recordings for the five minute baseling period were taken.

<u>Statistical Analysis of Data</u>

Means and standard deviations for all scores are reported in Table 1. To test the hypothesis of a positive relationship between

psychological (self-report) and physiological (muscle tension levels) measures of anxiety, the correlations were determined by the Pearson product-moment correlation coefficient (Ferguson, 1971, p. 99). Havelicek and Peterson (1977) have suggested that "the Pearson r can be used in nearly all situations in which there is a need for a measure of relationship between two variables, regardless of the shape of the distributions of scores or the type of scales being used" (p. 377).

Limitations of the Study

The present study was concerned solely with examining the relationship between self-report measures of anxiety and muscle tension levels as measured by frontal EMG.

CHAPTER IV

SUMMARY OF STATISTICAL ANALYSIS

Basically, Chapter IV comprises a restatement of the hypotheses delineated in Chapter II, together with a presentation of the related findings and conclusions. In order to test the hypotheses of a positive relationship between psychological (self-report) and physiological (muscle tension level) measures of anxiety, correlations were determined by calculating the Pearson product-moment correlation coefficient (Ferguson, 1971).

Looking first at the means of all scores, which are reported in Table 1, it was noted that the mean scores of the self-evaluation inventories for the sample were slightly higher than those reported in the handbooks. No statement about the mean EMG levels can be made at this time because of a lack of published EMG baseline data.

HYPOTHESIS 1

A positive relationship between state anxiety, as measured by the STAI-S, and muscle tension level, as measured by frontalis EMG level, will be indicated.

Findings

To test Hypothesis 1, the Pearson product-moment correlation coefficient was computed. The results of the analysis, as shown in Table 2, did not confirm the existence of a positive relationship between A-State and muscle tension level ($r=.101$, $p=.203$).

Conclusion

On the basis of this statistical analysis, Hypothesis 1 was not

Table 1

Group Means of Anxiety Measures for 160 Subjects

Instrument	Mean	SD
STAI-S	44.824	10.609
STAI-T	48.262	9.943
IPAT	40.481	11.624
EMG	2.044	1.003

Table 2

Relationship Between Measures of Anxiety

Correlations Matrix

	STAI-S	STAI-T	IPAT	EMG
STAI-S	1.000	0.564	0.481	0.101
STAI-T	0.564	1.000	0.728	0.129
IPAT	0.481	0.728	1.000	0.194
EMG	0.101	0.129	0.194	1.000

Probabilities of r

	STAI-S	STAI-T	IPAT	EMG
STAI-S	0.000	0.000	0.000	0.203
STAI-T	0.000	0.000	0.000	0.105
IPAT	0.000	0.000	0.000	0.014
EMG	0.203	0.105	0.014	0.000

Degrees of Freedom = 158

accepted.

HYPOTHESIS 2

A positive correlation between trait anxiety, as measured by the STAI-T, and muscle tension, as measured by frontalis EMG level, will be obtained.

Findings

The Pearson r was used to test Hypothesis 2. The correlation coefficient obtained ($r=.129$, $p=.105$) did not reach statistical significance.

Conclusion

On the basis of this analysis, Hypothesis 2 was not accepted.

HYPOTHESIS 3

Anxiety, as measured by Cattell's IPAT, will be positively correlated with muscle tension level, as measured by frontalis EMG level.

Findings

The correlation coefficient between IPAT self-report measures of anxiety and EMG levels, as determined by the Pearson product-moment coefficient, was statistically significant ($r=.194$, $p=.014$).

Conclusion

On the basis of this analysis, Hypothesis 3 was accepted.

SUMMARY

In summary, subjective levels of state and trait anxiety, as assessed by the State-Trait Anxiety Inventory, were not positively related to muscle tension levels as measured by frontal EMG. Self-evaluated anxiety as measured by the IPAT did correlate significantly with EMG measures of muscle tension.

CHAPTER V

DISCUSSION AND IMPLICATIONS

Discussion of Results

Since most experimental literature dealing with anxiety reports low correlations between psychological and physiological measures of anxiety, many studies use both types of measures when testing hypotheses on anxiety. The present study used self-report measures, obtained from the STAI (Spielberger et al., 1970) and the IPAT (Cattell & Scheier, 1963), and muscle tension levels, as measured by frontalis EMG. The results of the study indicated that self-report and frontalis EMG measures of anxiety are positively related. However, the instrument used to assess the subjective ratings of anxiety appears to be an important consideration since the IPAT was the only self-report measure to correlate significantly with baseline EMG level.

The study involved 160 subjects, 56 males and 104 females, a sample amply large to provide reliable results. Therefore, it seemed worthwhile to examine the anxiety inventories in explaining the results. Of import is the fact that the handbook states that IPAT scores correlated significantly with physiological measures of anxiety (p. 7). A similar correlation is not reported in the STAI manual. Further inspection of the two inventories highlights essential differences in format. STAI statements tend to be concise and evaluative, whereas the IPAT comprises longer statements situated within specific contexts which seem to elicit reactions rather than evaluations. For example, the STAI states "I feel overexcited and 'rattled', while the

IPAT says, "I tend to get over-excited and 'rattled' in upsetting situations." Or, "I am a steady person" compared to "My spirits generally stay high no matter how many troubles I meet"; and finally, "I try to avoid facing a crisis or difficulty" contrasted with "I tend to tremble or perspire when I think of a difficult task ahead." These considerations of basic differences between the STAI and the IPAT seem to recommend the IPAT as the more sensitive instrument in assessing subjective anxiety.

Although the IPAT was the only self-report measure to correlate significantly with baseline EMG level, it is noteworthy that the correlations between the STAI-S, STAI-T, and IPAT are all significant.

Implications

There is need for further empirical evidence that a significant positive relationship exists between muscle tension, as measured by frontal EMG level, and subjective reports of anxiety, as measured by the IPAT. It is recommended that a large sample be used to obtain reliable results. In order to confirm the positive relationship between the two measures of anxiety, it is essential to investigate anxiety without a treatment component. Only after such evidence has been obtained should investigation between the anxiety measures after treatment be investigated.

The results of the study further suggest that serious consideration should be given to the practice of using the frontalis muscle as the prime monitoring site in anxiety studies involving EMG. Evidence exists that some individuals respond to stress with increases in skeletal muscular tension, while others do not. Also, it seems that responsive

individuals tend to have ideosyncratic patterns of muscle tension whereby they are able to maintain different levels of tension in different regions of the skeletal musculature. Therefore, it may be more useful to monitor multiple sites simultaneously in order to obtain recordings from the most reactive muscle group. Furthermore, since many individuals respond to stress with other physiological reactions, such as peripheral vasoconstriction, increases in heartrate and respiration, and changes in GSR, it would seem most useful to ascertain the individual's pattern of physiological reactivity through a stress profile, as suggested by Hiebert (1979), and study the correlations of the most responsive physiological parameter and self-report measures of anxiety.

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